CLAIMS

1. A method of forming a crystalline film comprising a first step of forming a thin film on a substrate, and a second step of crystallizing at least the surface layer of the thin film, wherein;

in the second steps, at least the surface layer of the thin film is melted and crystallized under a hydrogen-containing atmosphere.

2. A method of forming a crystalline film according to Claim 1, wherein the thin film is a semiconductor thin film.

3. A method of forming a crystalline film according to Claim 1, wherein the thin film is a metallic thin film.

4. A method of forming a crystalline film according to Claims 1 to 3, wherein the second step is carried out under atmospheric pressure.

5. A method of forming a crystalline film according to Claims 1 to 4, wherein the hydrogen-containing atmosphere contains an inert gas and hydrogen molecules.

6. A method of forming a crystalline film according to Claims 1 to 4, wherein the hydrogen-containing atmosphere contains an inert gas and a hydrogen halide.

7. A method of forming a crystalline film according to Claims 5 and 6, wherein the inert gas is a rare gas.

8. A method of forming a crystalline film according to Claims 5 and 6, wherein the rare gas is argon.

9. A method of forming a crystalline film according to Claims 1 to 8, wherein in the second step, at least the surface of the thin film is melted by supplying high energy to the thin film.

10. A method of forming a crystalline film according to Claim 9, wherein the form of the high energy is light.

11. A method of forming a crystalline film according to Claim 9, wherein the form of the high energy is a laser beam.

12. A method of forming a crystalline film comprising a first step of forming a semiconductor thin film on a

substrate, and a second step of crystallizing at least the surface layer of the semiconductor thin film, wherein;

in the second steps, at least the surface layer of the semiconductor thin film is melted and crystallized under an atmosphere containing a gas containing the component element of the semiconductor thin film.

13. A method of forming a crystalline film according to Claim 12, wherein the second step is carried out under atmospheric pressure.

14. A method of forming a crystalline film according to Claim 12 and 13, wherein the gas containing the component element of the semiconductor thin film is a hydride of the component element.

15. A method of forming a crystalline film according to Claim 12 and 13, wherein the semiconductor thin film is a silicon thin film, and the gas containing the component element of the semiconductor thin film is silane.

16. A method of forming a crystalline film according to Claims 12 to 15, wherein in the second step, at least the surface of the semiconductor thin film is melted by

supplying high energy to the semiconductor thin film.

17. A method of forming a crystalline film according to Claim 16, wherein the form of the high energy is light.

18. A method of forming a crystalline film according to Claim 16, wherein the form of the high energy is a laser beam.

19. A high energy supply apparatus at least comprising a generation source for generating high energy and a supply chamber for supplying high energy to an object material, wherein:

the supply chamber has the function to set the object material therein;

the supply chamber has an introduction window provided a portion of the supply chamber, for introducing the high energy therein; and

the introduction window is provided at a position where the component of the object material hardly adheres to the introduction window when the high energy is supplied to the object material.

20. A method of forming a crystalline film comprising a

first step of forming a thin film on a substrate, and a second step of crystallizing at least the surface layer of the thin film by supplying high energy thereto, wherein:

the second step is carried out in a high energy supply apparatus comprising a generation source for generating the high energy and a supply chamber for supplying the high energy to the thin film;

the thin film is set in the supply chamber;

the supply chamber has an introduction window provided in a portion thereof, for introducing the high energy thereinto; and

the high energy is supplied to the thin film with the introduction window provided at a position where the component of the thin film hardly adheres to the introduction window when the high energy is supplied to the thin film.

21. A method of forming a crystalline film according to Claim 20, wherein the thin film is a semiconductor thin film.

22. A method of forming a crystalline film according to Claim 20, wherein the thin film is a metallic thin film.

23. A method of forming a crystalline film according to Claims 20 to 22, wherein the form of the high energy is light.

24. A high energy supply apparatus at least comprising a generation source for generating high energy and a supply chamber for supplying high energy to an object material, wherein:

the supply chamber has the function to set the object material therein;

the supply chamber has an introduction window provided a portion of the wall of the supply chamber, for introducing the high energy therein; and

the distance between the introduction window and the object material is larger than the shortest distance between the wall and the object material.

25. A method of forming a crystalline film comprising a first step of forming a thin film on a substrate, and a second step of crystallizing at least the surface layer of the thin film by supplying high energy thereto, wherein:

the second step is carried out in a high energy supply apparatus comprising a generation source for generating the high energy and a supply chamber for

supplying the high energy to the thin film;

the thin film is set in the supply chamber;

the supply chamber has an introduction window provided in a portion of the wall thereof, for introducing the high energy thereinto; and

the high energy is supplied to the thin film with the distance between the introduction window and the thin film larger than the shortest distance between the wall and the thin film.

26. A method of forming a crystalline film according to Claim 25, wherein the thin film is a semiconductor thin film.

27. A method of forming a crystalline film according to Claim 25, wherein the thin film is a metallic thin film.

28. A method of forming a crystalline film according to Claims 25 to 27, wherein the form of the high energy is light.

29. A high energy supply apparatus at least comprising a generation source for generating high energy and a supply chamber for supplying high energy to an object material,

wherein:

the supply chamber has the function to set the object material therein;

the supply chamber has an introduction window provided a portion of the wall of the supply chamber, for introducing the high energy therein; and

the supply chamber has pressure regulating means for permitting the pressure in the vicinity of the introduction window to be higher the pressure in the vicinity of the object material.

30. A method of forming a crystalline film comprising a first step of forming a thin film on a substrate, and a second step of crystallizing at least the surface layer of the thin film by supplying high energy thereto, wherein:

the second step is carried out in a high energy supply apparatus comprising a generation source for generating the high energy and a supply chamber for supplying the high energy to the thin film;

the thin film is set in the supply chamber;

the supply chamber has an introduction window provided in a portion of the wall thereof, for introducing the high energy thereinto; and

the high energy is supplied to the thin film under

the pressure in vicinity of the introduction window higher than the pressure in the vicinity of the thin film in the supply chamber.

31. A method of forming a crystalline film according to Claim 30, wherein the thin film is a semiconductor thin film.

32. A method of forming a crystalline film according to Claim 30, wherein the thin film is a metallic thin film.

33. A method of forming a crystalline film according to Claims 30 to 32, wherein the form of the high energy is light.

34. A high energy supply apparatus at least comprising a generation source for generating high energy and a supply chamber for supplying high energy to an object material, wherein:

the supply chamber has the function to set the object material therein;

the supply chamber has an introduction window provided a portion of the wall of the supply chamber, for introducing the high energy therein, and an exhaust port

for exhausting the supply chamber; and

the supply chamber has pressure regulating means for permitting the pressure in the vicinity of the introduction window to be higher the pressure in the vicinity of the object material, and the pressure in the vicinity of the object material to be higher than the pressure in the vicinity of the exhaust port.

35. A method of forming a crystalline film comprising a first step of forming a thin film on a substrate, and a second step of crystallizing at least the surface layer of the thin film by supplying high energy thereto, wherein:

the second step is carried out in a high energy supply apparatus comprising a generation source for generating the high energy and a supply chamber for supplying the high energy to the thin film;

the thin film is set in the supply chamber;

the supply chamber has an introduction window provided in a portion of the wall thereof, for introducing the high energy thereinto, and an exhaust port for exhausting the air in the supply chamber; and

the high energy is supplied to the thin film under the pressure in vicinity of the introduction window higher than the pressure in the vicinity of the thin film, and

the pressure in the vicinity of the thin film higher than the pressure in the vicinity of the exhaust port in the supply chamber.

36. A method of forming a crystalline film according to Claim 35, wherein the thin film is a semiconductor thin film.

37. A method of forming a crystalline film according to Claim 35, wherein the thin film is a metallic thin film.

38. A method of forming a crystalline film according to Claims 35 to 37, wherein the form of the high energy is light.

39. A high energy supply apparatus at least comprising a generation source for generating high energy and a supply chamber for supplying high energy to an object material, wherein:

the supply chamber has the function to set the object material therein;

the supply chamber has an introduction window provided a portion of the wall of the supply chamber, for introducing the high energy therein;

the object material is irradiated with the high energy introduced into the supply chamber through the introducing window along an irradiation path assumed in the supply chamber;

part of the high energy enters the object material, and another part is reflected from the object material and travels along a reflection path assumed in the supply chamber;

a gas flow is present in the supply chamber; and

the supply chamber has gas flow regulating means for permitting the gas flow from the introduction window to the object material in substantially the same direction as the irradiation path, and a gas flow from the object material in substantially the same direction as the reflection path.

40. A method of forming a crystalline film comprising a first step of forming a thin film on a substrate, and a second step of crystallizing at least the surface layer of the thin film by supplying high energy thereto, wherein:

the second step is carried out in a high energy supply apparatus comprising a generation source for generating the high energy and a supply chamber for supplying the high energy to the thin film;

the thin film is set in the supply chamber;

the supply chamber has an introduction window provided in a portion of the wall thereof, for introducing the high energy thereinto;

the thin film is irradiated with the high energy introduced into the supply chamber through the introduction window along a irradiation path assumed in the supply chamber;

part of the high energy enters the thin film, and another part is reflected from the thin film along a reflection path assumed in the supply chamber;

a gas flow is present in the supply chamber; and

the high energy is supplied to the thin film with the gas flow from the introduction window to the thin film in substantially the same direction as the irradiation path, and the gas flow from the thin film in substantially the same direction as the reflection path.

41. A method of forming a crystalline film according to Claim 40, wherein the thin film is a semiconductor thin film.

42. A method of forming a crystalline film according to Claim 40, wherein the thin film is a metallic thin film.

43. A method of forming a crystalline film according to Claims 40 to 42, wherein the form of the high energy is light.

44. A high energy supply apparatus at least comprising a generation source for generating high energy and a supply chamber for supplying high energy to an object material, wherein:

the supply chamber has the function to set the object material therein;

the supply chamber has an introduction window provided a portion of the wall of the supply chamber, for introducing the high energy therein;

the thin film is irradiated with the high energy which is introduced into the supply chamber through the introduction window along an irradiation path assumed in the supply chamber; and

the introduction window is disposed so that the normal line of the thin film is shifted from the direction of the irradiation path.

45. A high energy supply apparatus at least comprising a generation source for generating high energy and a supply chamber for supplying high energy to an object material,

wherein:

the supply chamber has setting means for setting the thin film therein;

the supply chamber has an introduction window provided a portion of the wall of the supply chamber, for introducing the high energy therein;

the thin film is irradiated with the high energy which is introduced into the supply chamber through the introduction window along an irradiation path assumed in the supply chamber; and

the setting means is disposed so that the normal line of the thin film is shifted from the direction of the irradiation path.

46. A method of forming a crystalline film comprising a first step of forming a thin film on a substrate, and a second step of crystallizing at least the surface layer of the thin film by supplying high energy thereto, wherein:

the second step is carried out in a high energy supply apparatus comprising a generation source for generating the high energy and a supply chamber for supplying the high energy to the thin film;

the thin film is set in the supply chamber;

the supply chamber has an introduction window

provided in a portion of the wall thereof, for introducing the high energy thereinto;

the thin film is irradiated with the high energy introduced into the supply chamber through the introduction window along a irradiation path assumed in the supply chamber; and

the high energy is supplied to the thin film with the normal direction of the thin film shifted from the direction of the irradiation path.

47. A method of forming a crystalline film according to Claim 46, wherein the thin film is a semiconductor thin film.

48. A method of forming a crystalline film according to Claim 46, wherein the thin film is a metallic thin film.

49. A method of forming a crystalline film according to Claims 46 to 48, wherein the form of the high energy is light.

50. A high energy supply apparatus at least comprising a generation source for generating high energy and a supply chamber for supplying high energy to an object material,

wherein:

the supply chamber has the function to set the thin film therein;

when the high energy is introduced into the supply chamber to irradiate the object, part of the high energy enters the object material, and another part is reflected from the object material to form reflected energy; and

the supply chamber and course changing means for irradiating again the object material with the reflected energy.

51. A high energy supply apparatus according to Claim 50, wherein the course changing means has the time regulating function to delay the time of irradiation of the object material with the reflected energy.

52. A high energy supply apparatus according to Claim 51. wherein the time regulating function comprises a plurality of reflection means for reflecting the high energy.

53. A high energy supply apparatus according to Claims 50 to 52, wherein the course changing means has the positioning function to permit a desired position of the thin film to be irradiated with the reflected energy.

54. A high energy supply apparatus according to Claims 50 to 53, wherein the high energy is light, and the course changing means comprises a mirror.

55. A high energy supply apparatus according to Claims 50 to 53, wherein the high energy is light, and the course changing means comprises converging means.

56. A method of forming a crystalline film comprising a first step of forming a thin film on a substrate, and a second step of crystallizing at least the surface layer of the thin film by supplying high energy thereto, wherein:

the second step is carried out in a high energy supply apparatus comprising a generation source for generating the high energy and a supply chamber for supplying the high energy to the thin film;

the thin film is set in the supply chamber;

the supply chamber has an introduction window provided in a portion of the wall thereof, for introducing the high energy thereinto;

when a first position of the thin film is irradiated with the high energy introduced into the supply chamber, part of the high energy enters the thin film; and

another part of the high energy is reflected to form

reflected energy with which a second position of the thin film is then irradiated through a course changed.

57. A method of forming a crystalline film according to Claim 56, wherein during the time the first position is irradiated with the high energy, irradiation of the second position with the reflected energy corresponding to the high energy is started.

58. A method of forming a crystalline film according to Claims 56 and 57, wherein the first position is substantially the same as the second position.

59. A method of forming a crystalline film according to Claims 56 to 58, wherein the thin film is a semiconductor thin film.

60. A method of forming a crystalline film according to Claims 56 to 58, wherein the thin film is a metallic thin film.

61. A method of forming a crystalline film according to Claims 56 to 60, wherein the form of the high energy is light.

62. A method of manufacturing a thin film electronic device comprising a crystalline film, wherein the crystalline film is formed by a method according to any one of Claims 1 to 18, 20 to 23, 25 to 28, 30 to 33, 35 to 38, 40 to 43, 46 to 49, and 56 to 61.

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